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Edgar F. Higgins

ON  
COUNTER-IRRITATION.

A THEORY  
CONSTRUCTED BY THE  
DEDUCTIVE METHOD OF INVESTIGATION.

BY  
JAMES ROSS, M.D.,  
NEWCHURCH, NEAR MANCHESTER.

*Price One Shilling.*

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## P R E F A C E.

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IN the following pages an attempt is made to place the theory of counter-irritation upon the basis of solidism. The physiology and pathology of the present day are in a great measure founded upon solidism; but, strange to say, a great part of therapeutics is founded upon the exploded doctrines of fluidism and neuropathology.

This view of the action of counter-irritation was adopted by me in 1862, and in the 'British Medical Journal' for Sept. 17th, 1863, appeared a letter in which I stated the essential features of the theory advanced in these pages. In the paper which I now submit to the judgment of my medical brethren I have attempted to prove a theory which I formerly stated merely as a matter of private opinion.

I may also state that my aim has been, not only to advance a theory of counter-irritation, but also to illustrate a Method of Investigation. I wish to call special attention to this point, because it will account for the free employment of logical technicalities in the text, and because this method is in my opinion the one destined to regenerate Therapeutics. It is what Mill calls "the Concrete Deductive Method;" in fact, the method by which Newton constructed the science of Astronomy. But this method cannot be applied in all its strictness to medical science in the present state of our

knowledge. It must be largely supplemented by hypotheses. I have therefore thought it expedient to give formal expression to the laws which ought to govern a scientific hypothesis; for if medical men have these laws steadily in view, they will be kept more within the bounds of sobriety in framing their hypotheses.

NEWCHURCH ;

*April 13th, 1869,*



## ON COUNTER-IRRITATION.

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COUNTER-IRRITATION is a term employed to designate any irritation artificially established with a view to influence in some manner another morbid process existing in the body; and the agent employed to produce the artificial irritation is termed a counter-irritant.

Various hypotheses have at different times been advanced to explain the manner in which counter-irritants produce their action; and the fact that two or three of these have currency in our present medical literature is sufficient to show that no theory has hitherto been advanced which is satisfactory to the minds of all. "The action of counter-irritants," says Dr. Bennett, "although undoubtedly useful in removing pain and in causing absorption of chronic exudations, is little understood, and belongs to the most mysterious department of therapeutics."

Before either attempting to pass in review the hypotheses of others or to construct a theory of my own, it is necessary to have a clear conception of the effects which counter-irritants produce upon the morbid structures in the neighbourhood of which they are applied; in other words, it is necessary to collate instances of the effects, and to describe accurately the results of our observations; or, as Dr. Whewell expresses it, "to colligate facts by appropriate conceptions." But our time need not be occupied in giving a detailed account of individual cases, as every medical man has had ample opportunities of observing the effects of counter-irritants, and as the empirical laws by which the practitioner is guided at the bed-side are short expressions of the results of these observations. It is enough, therefore, to lay down those empirical laws with only such amplifications and ex-

planations as shall render them sufficiently expressive of the observed facts upon which they are founded.

(1) It is a practical maxim not to apply a counter-irritant in the early stage of inflammation, as the disease may be aggravated by it. Now, although this law is unobjectionable as a practical maxim, it does not sufficiently express all the effects of counter-irritants in the early stage of inflammation. It is a very common remedy to apply a mustard poultice in the early stage of bronchitis, and it must be acknowledged that this is frequently followed by relief to the patient. But let us attend carefully to what the counter-irritant effects in this instance. In the first stage of bronchitis there is a feeling of constriction of the chest, dry cough, and difficulty of breathing. Now, when the mustard poultice is followed by relief to these symptoms, it is not health that is substituted, but other symptoms, which, although not so distressing to the patient, are equally with the former indicative of disease. The difficulty of breathing is relieved, but still there is a cough which is attended with expectoration of mucus. It is needless for me to point out that such a mucous membrane is not in a state of health. It is in the very condition which the natural course of the disease tends to develop. The mucous membrane is now in the second stage of inflammation, a condition often less distressing to the patient than the first, but not on that account the less an actual state of disease. All, therefore, that can be fairly attributed to the action of the counter-irritant in this case is that the second stage had become developed sooner than it would in the natural course of the morbid process. In short, the counter-irritant may be presumed to have shortened the duration of the first stage of the disease, but not to have otherwise altered its course. Other instances might be adduced to illustrate this effect of counter-irritation, such as the rapid effusion of fluid after the application of a blister in the first stage of pleurisy, with relief to the "stitch." Now, it has been said that counter-irritation "allays" inflammation. If by this it is meant that counter-irritation relieves symptoms, it may be true; but if it is meant that it has a tendency to reduce directly the inflammatory process to a state of health, an example illustrative of this effect has never come under my notice. I have cautiously employed counter-irritation in the first stage of inflammation, and seen it employed by others, but I never saw a single case where the first stage of inflammation was followed by health; the invariable result has been the progress of the disease into

the second stage. It may, therefore, be laid down as an empiric law that when counter-irritation is employed in the first stage of inflammation, it has a tendency to develop the second stage, and has also a tendency, which is not manifested on all occasions, to extend and aggravate the disease.

(2) All practitioners are agreed that the beneficial action of counter-irritation is most manifest in the second stage of inflammation. Ample experience has proved that it promotes absorption of effused fluids, and tends to diminish the quantity and improve the quality of muco-purulent discharges.

(3) In practice counter-irritation is employed with very marked effect in the treatment of many other diseases which have no analogy to inflammation. Take, for instance, flatulent colic, retention of urine from partial paralysis of the bladder, and valvular disease of the heart. The groups of symptoms which indicate those diseases may occasionally be the result of the inflammatory process, but there are many instances of such diseases which have not resulted from previous inflammation, and the effects of counter-irritants are as marked in the latter as in the former cases. It is obvious, therefore, that if we only take cognizance of the action of counter-irritants upon the inflammatory process, even our empiric laws will be defective, and still more defective and partial will that theory be which does not afford an explanation of every effect of those agents, whether for good or for evil, in all the cases in which they have been employed; unless, indeed, the difficulty arises from our want of knowledge of the disease, and not from our want of knowledge of the action of the remedy. As at present I am only in search of empiric laws, it is not necessary to enter into an analysis of these cases; it is sufficient to notice that there are morbid states, not of inflammatory origin, over which counter-irritants exert a beneficial influence, that is, a tendency to promote the return of the morbid structure to a state of health.

(4) Another practical rule, is not to apply a counter-irritant too near the seat of the disease, for fear of aggravating it—nor too far removed from the disease, lest it fail to have the desired effect. It follows as a corollary that the nearer the counter-irritant is applied to the seat of the disease the more marked is the effect for good or for evil, and the further removed from the disease it is applied the effect obtained is the less marked.

(5) Another empiric law is, that the greater the irritation and the deeper the destruction of the skin caused by the



counter-irritant, the more marked and the more permanent is the effect. Hence the division of counter-irritants into Rubefacients, Vesicants, Pustular counter-irritants, Issues, &c.

(6) The last empirical law which I shall mention is, that direct continuity of tissue is not required in order that the effects of counter-irritants may become manifest. Take, for instance, morbid states of the lung; that organ, although contiguous to, is not in continuity with, the walls of the thorax, and yet a counter-irritant applied to the surface of the chest produces a marked effect upon certain morbid conditions of the lung.

These, then, are some of the empirical laws for which a theory of the action of counter-irritants ought to afford an *à priori* explanation. It is not pretended that all the effects of counter-irritants are embodied in these empirical laws, nor is it necessary that they should be. For instance, it is a fact ascertained from observation that counter-irritation, especially when long continued, weakens the body, but it is not necessary to give a formal expression to this effect, since it does not come directly within the scope of this inquiry to examine into the effects counter-irritants produce upon the body as a whole. This is an examination into the effects counter-irritation produces upon a morbid locality in the neighbourhood of which it is applied; therefore it would encumber the inquiry to enter into a discussion of the different effects it may produce upon the body as a whole, except so far as a general effect may react upon a diseased locality.

The causes which concur to produce the effects expressed in these empirical laws must now be analysed, and these causes may be considered under the following heads.

I. The disease or diseases existing antecedently to the application of the counter-irritant.

II. The disease artificially produced in order to exert some influence over the course of the former.

III. The conducting medium through which this influence is conveyed from the artificial irritation to the morbid structure.

I. With regard to the diseases existing antecedently to the application of the counter-irritant, the most important is inflammation. It is therefore necessary to lay down a theory of this process. It is foreign to my purpose to enter into any pathological discussion, and therefore I shall lay down more or less dogmatically the theory of the process to which I shall

adhere, since to strengthen such a theory with arguments would require more time and space than I can at present afford. It may be remarked, in the first place, that inflammation is not a single state, but a succession of states; it is a progression or series, and any theory that does not recognise it as such is of no use for our present purpose, because the solution of the whole question before us must turn upon this point. It is therefore essential that the successive terms of which this series consists be clearly ascertained. A remedy has been applied which has deflected the disease from what is presumed to be its natural to some other course; and how can the laws of action of the agent that has produced this deflection be determined unless the natural course of the disease is known, and the causes which concur to produce the motion of the disease in this course ascertained. The perturbations in the motion of the planets could not be ascribed to the mutual attraction of the planets among themselves, unless it had been previously proved that the central force of the sun and the tangential force would cause the planet to describe an ellipse in its revolution round the sun. Two distinct operations have therefore to be performed in laying down a theory of inflammation; the first is to investigate the causes which concur to originate and maintain the process, and the second is to arrive at a short description of the course inflammation pursues in its progress; the first operation being analogous to Newton's when he deduced the orbit of the planets from the causes which concur to produce their motion, namely, the central force of the sun and the original impact; and the second being analogous to Kepler's operation when he colligated the results of his observations of the motion of the planets under the conception of an ellipse.

With regard to the causes of inflammation, then, I agree with those pathologists who believe that the tissues of the part affected by the disease take the most important step in the initiation of the process. The cells of the part possess the property of responding to certain stimuli, and when the action of these cells becomes increased there is an influx of blood to the part to minister to their demands. "The action," says Simon, "whereby inflammation begins is one which, physiologically speaking, cannot be distinguished from hypertrophy." But although the primary step in inflammation is one of excessive action, it does not follow that the whole course of the process is characterised by increased nutritive activity. "But a part," says Virchow, "that takes



up a large quantity of material need not on that account necessarily fall into a permanent condition of enlargement, but, on the contrary, under these very circumstances, there often arises subsequently in its internal economy a disturbance which imperils the persistence of the part, and becomes the proximate cause of its destruction." When the action of the part reaches a certain intensity, 'stasis' of blood occurs in some of the capillaries. It is not necessary for me to commit myself to any theory of how 'stasis' is caused, but it is manifest that whenever it does occur its immediate effect will be to diminish the supply of nourishment to the tissues of the part affected, and also in a great measure to suspend absorption. It is needless to notice more minutely all the effects that follow from 'stasis' of blood in the capillaries; it is enough for my purpose to say that after it takes place the course of inflammation is characterised by a deficiency of nutrition, and this is true notwithstanding that there may be a rapid production of cells going on in the part. The cells of the affected tissues have received the formative impulse during the first stage of the inflammatory process, their nuclei have divided, and now they continue to multiply, but, being sparingly supplied with nourishment, degenerate into low forms of organic life. But the process does not end here, since the tissue affected manifests a tendency to return to the original type of its nutrition, and even when the nourishment of the part has been so completely cut off by 'stasis' of the blood in the capillaries as to produce death of a portion of the tissue affected, the injury is afterwards repaired to a certain extent. From empirical observation of the effects of this tendency it has been termed the "*vis medicatrix naturæ*," and to account for it the tissues of the body are assumed to be possessed of a formative or constructive force. This force, "and those that co-operate with it may be," as Paget suggests, "the same with those which actuated the formation of the original tissues in the development of the germ and of the embryo." But whatever generalisations may be made with regard to the force or forces operative in repairing injuries, it is sufficient for my purpose to notice that there is an internal force existing in the part affected by the second stage of inflammation which tends to restore the morbid structure to the original type of nutrition.

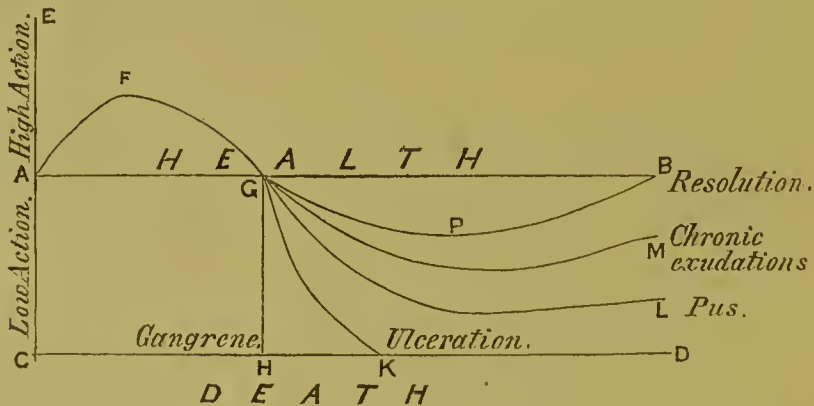
It has already been stated that it was my intention to avoid as much as possible pathological discussions, but it

may not be out of place to endeavour to remove one or two objections which may be urged against this theory of inflammation. Not only may agents which are termed irritants or stimulants be the exciting cause of inflammation, but the process may be originated by depressants, such as cold. But, as Simon remarks, "cold continuously applied is the sedative of every vital manifestation;" and if cold causes inflammation it may be asked how can the first step in the process be characterised by increased nutrition? The answer to this is, that cold continuously applied is never the direct cause of inflammation. If the cold applied is extreme it may cause death of the part, and if less intense it may only cause partial death; but whether corporate or partial death of the part takes place, the effect upon the surrounding tissues is the same except in degree—the dead part acts as an irritant to the healthy tissues, and inflammation is the result. "By what method of operation it is," says Simon, "that textural death (however produced, and in whatever proportion) becomes provocative of textural renewal, we know not." It must at present be taken as an ultimate fact in the life history of cells, that whenever living are in contact with dead cells the former make an effort to rid themselves of the presence of the latter, and in this manner a high action is originated in the part. But this high action is only an indirect result of the depressant. Heat and mechanical and chemical influences, when so excessive as to cause destruction of the part, act also in this indirect manner in causing inflammation. But this difference may frequently be noticed—that heat, for instance, when so excessive as to produce death of a part of the body, has just been sufficient to cause textural excitement in the surrounding tissues; hence inflammatory action begins sooner after the application of excessive heat than of cold.

Another objection which might be raised against this theory of inflammation is that some pathologists refuse to accord the name 'inflammation' to the process until exudation takes place, that is, until 'stasis' of blood has occurred in some of the capillaries, and, in short, till what has been termed the second stage of inflammation is established. But this is a mere question of nomenclature, and does not enter into a distinction between the nature of things. Such a distinction may be useful for the purposes of diagnosis, but unless carefully watched may mislead us in the study of the successions of the disease. There is no objection to call the

first stage of the process 'active congestion' or simply 'irritation,' and only to apply the term 'inflammation' when the second stage of the process is fully established, if it be remembered that the disease consists of a succession of morbid states, and that if one name be applied to one or more terms of the series, and another to the remaining terms, this is perfectly legitimate as a matter of nomenclature; but in theory the whole process, from its first deviation from health, however slight that deviation may be, to its termination, must be looked upon as one unbroken chain of phenomena. In the following pages 'inflammation' will be used as a generic term, including the whole process from its first deviation from health to its various terminations. The slighter shades of the disease in which exudation is not expected to ensue will be termed 'irritation;' but when the disease in its early progress is of sufficient intensity to lead inevitably to exudation, that stage will be termed 'the first stage of inflammation.' When exudation has taken place this will be termed the 'second stage of inflammation,' and when I have occasion to allude to any one of the various terminations of the process the ordinary nomenclature will be employed.

Having briefly alluded to the active forces existing in a part, by which the inflammatory process is originated and carried to its various terminations, I shall attempt to perform the second step of the operation, that is, to represent the course inflammation takes by an appropriate description. The course of this disease might be represented by the system of straight and curved lines in the accompanying diagram.



Let the straight line A B represent the progress of a part in health, and C D the boundary where death occurs; the



intermediate space will represent the region of defective nutrition, and the undefined space above A B, the line of health, will represent the region of high nutritive activity. The curve A F G will represent the first stage, and G P B the second stage of inflammation, when resolution is obtained; G H when the inflammation ends in gangrene, and the intermediate lines between H and B will represent its course when it ends in the other events of the process. It would be possible to represent the progress of inflammation with its various terminations by such a system of lines with very great accuracy, but such a method of representation would be too complicated and encumbered to too great an extent with details. The colligation of the facts in this instance is required for the purposes of the art of medicine, and even accuracy of representation must to a certain extent be sacrificed to brevity of description. But if the progress of inflammation be represented by saying that the first stage is characterised by an excess, while the second is characterised by a diminished nutrition, this will have the advantage of brevity, while accuracy of representation is to a considerable extent secured, and whenever greater accuracy is required an appeal can be made to the general theory of the subject. This mode of representing the course of inflammation will be attended with another advantage so far as the art of medicine is concerned. The healthy nutrition of a locality is made the central idea of the representation, and the major premise upon which the art is founded is that the attainment of a healthy body is a desirable end. Reverting now for a moment to the empirical laws of the effects of counter-irritants, the first expresses the action of counter-irritation in the first stage of inflammation, when the nutrition of the part is in excess, while the second expresses the effect it produces in the second stage, when the nutrition of the part is below the standard of health.

I shall now consider the diseases of a non-inflammatory origin existing antecedently to the application of the counter-irritant. It is necessary to analyse a few of those cases, to see if it be possible to arrive at a distinct understanding as to their nature. In a case, for example, of paralysis of the bladder from over distension there are few that will deny that a blister applied above the pubes is a valuable remedial agent, and yet there has been no previous inflammation. The supposed case is one of weakness of the muscular coat of the bladder, and from this weakness it may be inferred

that the nutrition of that structure is defective. Flatulent colic often occurs in flabby women, and is frequently relieved by the application of a sinapism. In such a case the muscular coat of the bowel is in a state of defective nutrition without any previous inflammatory action, and yet the effect of the counter-irritant manifests a tendency towards establishing health. In cases of atrophy of muscle from inactivity, such as that which occurs after fractures, there is simply defective nutrition; and friction with stimulating liniments tends to restore these muscles to their former capacity for performing their functions. In cases of valvular disease of the heart the symptoms are sometimes ameliorated by keeping a small blistered surface over the præcordial region discharging pus for some weeks. When there is hypertrophy of the heart, before dilatation takes place to any great extent, if the walls of such a heart is compared with the walls of a healthy heart the former is a very powerful one; but if the comparison is based upon the work the heart has to perform it is a weak one, and the whole subsequent history of hypertrophied heart from valvular disease shows that its capacity for performing its function is falling further and further behind the work it has to perform. Therefore, keeping in view the comparison between the function of the heart and its capacity for performing that function, an hypertrophied heart may be said to be suffering from defective nutrition. At any rate, the indications of treatment are either to diminish the work the heart has to perform or to increase its capacity for its work; and as the small irritation on the surface does not fulfil the former indication, it must, if any advantage accrue from the application, act by fulfilling the latter. Therefore, all the cases of disease comprised under this head may be described with sufficient accuracy of representation by saying that the nutrition of the morbid locality is defective, and the third empirical law expresses the effect counter-irritation exerts over such instances of disease. Having now examined into the nature of the diseases existing antecedently to the application of the counter-irritant, and found that inflammation may be divided into two stages, the one characterized by increased, and the other by diminished nutritive activity; and also found that the remaining diseases for which counter-irritation is employed are cases where the nutrition is defective, I shall now proceed to consider—

II. The nature of the abnormal process artificially produced with the object of influencing a pre-existing disease.



It has already been remarked that the agent employed to produce the abnormal process artificially is termed a counter-irritant, and it may be laid down as a general proposition that counter-irritants excite inflammation. It may be that only slight irritation is caused, such as follows from the application of a rubefacient; or it may be that such a degree of inflammation is excited as will lead to effusion, as when a blister is applied, or to the formation of pus, as when a pustular counter-irritant is employed; or it may be that the counter-irritant is of a nature to produce immediate destruction of a portion of the surface, as when an issue is used, and in this case the inflammatory process is set up in the tissues surrounding the part that has been destroyed; but whatever may be the degree to which the morbid process is excited, and whatever may be the counter-irritant employed, the disease which ensues is inflammation of varying degrees of intensity. The theory of inflammation which I adopt has already been considered, and in order to explain the action of counter-irritation it is necessary from that theory to anticipate the nature of the influence which is conveyed to, or diverted from, the morbid process in its vicinity, and then to verify the result by reference to the empirical laws already laid down. But before this can be done successfully, I must briefly allude to—

III.—The conducting medium through which this influence is conveyed from the one to the other. That medium must be one or other of the tissues intervening between the two morbid localities. By the intervening tissues are meant, not only the structures by which a direct, but also those by which an indirect, connection is formed between the two localities, such as the nerves, for instance. With regard to the nutrition of those tissues, it may be said to be carried on according to the laws which govern the body in health, that is, according to physiological laws. But this proposition is only approximatively true, because when any locality is in a state of disease no part of the body can be nourished after the healthy type; but this deviation is so slight that for practical purposes it may be disregarded, that is, provisionally disregarded until the theory has been constructed. But if the theory fails to be verified by the great test of experience, and if, upon reconsideration, it is found that this slight deviation is the only way in which the error, which has crept into the theory, can be accounted for, it would then be unphilosophical to exclude it from our further consideration. It may, therefore, be laid down as a proposition sufficiently

true for my present purpose that the nutrition of the tissues intervening between the two morbid localities is carried on according to physiological laws.

The tissues intervening between the two morbid processes are parenchyma, blood, blood-vessels, nerves, and absorbents (lymphatics), and the influence which passes between these processes, whether attracted towards the surface and withdrawn from the interior, or generated at the surface and transmitted to the interior, must be conveyed by some one or other of these elements, or by a combination of them; and it will be hereafter seen that the various hypotheses current on this subject may be classified according as their authors consider that the blood-vessels, the blood, the nerves, or the absorbents, have been the conducting medium between the two processes.

The effects which counter-irritation produces upon the morbid structures in its vicinity have been noticed and formally expressed, and the causes which concur to produce those effects have been analysed. The synthetical operation by which a theory of the action of counter-irritation may be constructed must now be attempted. I have no right, however, to assume that this attempt devolves upon myself until I have subjected the theories of others to a rigorous examination. To such an examination, therefore, I shall now address myself. But before proceeding further it may be remarked that those theories or explanations are of the nature of hypotheses, and, therefore, it is not fair to test them by the laws of deduction or of induction; they must be tested by the laws which ought to govern a scientific hypothesis, and these laws are—

1. That the cause assumed be an actually existing antecedent, operating by known laws; or, in Newton's words, that it be a *vera causa*.

2. That the assumed cause account for the phenomena, that is, account for the empirical laws of the effects.

3. That no other assumption can account for the phenomena.

In applying these tests, the greatest importance will be attached to the second, or the experimental verification; and, of course, any hypothesis that fails to satisfy the demands of this great test must be rejected.

It has already been noticed that the current explanations of the action of counter-irritation may be classified according as it is considered that the influence exerted by it over a morbid structure in its vicinity is conveyed, by—I. The



blood-vessels. II. The blood. III. The nerves. And IV. The absorbents.

There are one or two apparent exceptions to this classification, but they are only apparent exceptions, for it will be perceived, on a little consideration of these explanations, that they are not explanations at all, but simple empirical laws. One of these is the old dogma that two diseases cannot exist in the system at the same time. So far is this from being the case, that it is a matter of the commonest observation that one disease predisposes to another. But were the truth of the dogma confirmed by the most careful observation, it would be an empirical law, which either required explanation as before, or placed the subject as an ultimate fact beyond the limits of our knowledge. The same remarks may be applied with very little variation to the so-called explanation advanced a few years ago by Dr. T. K. Chambers. This close observer of disease noticed that the beneficial action of blisters was not manifested at once, but that the absorption of fluid in pleurisy went on more rapidly as the blister began to heal; and he assumed that the healing process was the cause of the beneficial action of the counter-irritant. This is merely an observation with assumption of causation where the evidence only proves coincidence. But direct evidence of the falsity of the assumption can be obtained, for if a slight irritant be applied to the blistered surface, so as to retard the healing process, the effect of the counter-irritation will be more marked than if the healing process were allowed to proceed. But grant both the observation and assumption to be true, it affords no explanation of the action of counter-irritation, as the successive steps by which the irritation on the surface influences the morbid structures beneath are as unknown as before. Leaving, therefore, those futile attempts to elevate an empirical law into an explanation, I shall proceed to examine the hypotheses upon this subject which have currency in our present medical literature.

I. I shall first examine the theory which assumes that counter-irritation produces such changes in the blood-vessels, and in the force of the circulation within them, as will account for its action upon the morbid processes in its vicinity. This is the time-honoured derivation theory propounded in the infancy of pathology, when inflammation was supposed to be caused by a determination of blood to the part about to be affected. It was supposed that, when irritation was artificially produced near a morbid locality,

the flow of blood to the new irritation withdrew a certain amount of blood from the first disease, and that the latter was by this means controlled or allayed. This theory has been differently expressed at different times, in order to bring it into greater accord with the pathological doctrines of the day, but the assumption made is the same in all, namely, that a flow of blood not only takes place to the disease artificially produced, but that blood is also withdrawn from the structures in its neighbourhood; and although the blood will be admitted to flow to the former in obedience to a vital attractive force, the blood is supposed to be withdrawn from the latter in accordance with the laws of the dynamics of fluids. Such, then, being the derivation theory, let us try if it will satisfy the tests of a scientific hypothesis, and, first, is the cause assumed a *vera causa*? It is possible that when an irritant is applied to a part of the body supplied by branches of arterics which arise contiguous to the arteries which supply the diseased part, the flow of blood to the latter part may be diminished; but considering the free anastomosis of one artery with another, it is doubtful if even in such a case an increased flow of blood to one part would materially influence the arterial circulation in its neighbourhood.

The case is widely different when it is attempted to account for the action of counter-irritants upon the morbid processes of internal organs, such as the application of a blister to the surface of the chest in inflammation of the lungs. The surface of the chest is supplied by the intercostal arteries, which are branches of the aorta and of the subclavian artery; by the internal mammary, a branch of the subclavian; and by branches from the axillary artery; while the lung is supplied by the small bronchial arteries, which are branches of the aorta, and by the pulmonary arteries. It would be difficult to prove (and on the supporters of this theory lies the *onus probandi*), or even to give plausibility to the statement, that a flow of blood to a limited part of the surface of the chest would, according to the laws of the dynamics of fluids, influence the flow of blood through the lungs more than that through every part of the body. It might be expected that it would exert a greater influence over the supply of blood to the arms, since there is a more intimate connection between the arterics by which the walls of the chest are supplied and the subclavian and axillary arterics than between the former and those which supply the lungs. It may be said by the supporters of this theory that the



arteries of the body are different from the inert or even the elastic tubes with which experiments are carried on in physical science. This is no doubt true but if they seek refuge in this it is a virtual abandonment of the dynamical theory, which professes to afford an explanation from the circumstances in which the two agree. The conditions of the motion of fluids in dead and living tubes differ in many ways—such as the difference in the character of the fluid itself, the difference in the walls of the vessels—in the walls of the vessels being surrounded by living tissues and nerves, in the changes of which they and the fluid within them participate. But if an explanation be sought in any one or any combination of those differing circumstances the dynamical theory is abandoned, and merges into other theories which will be considered hereafter. Therefore this theory fails to satisfy the first test of a scientific hypothesis; at any rate it has not been proved, to say the least, that the cause assumed is a *vera causa*.

But let it be granted that a flow of blood to a limited part of the body will cause a diminished supply to the structures in its vicinity, whether they are directly continuous with each other or not, will this account for the empirical laws of the effects? In the first stage of inflammation there is an influx of blood to the part, and, if the supply of blood can be diminished by counter-irritation, as the theory assumes, it will tend to bring the inflammation back directly to the standard of health. When the inflammation is near the surface of the body this end is accomplished by the application of cold and by pressure. But the effect of counter-irritation in this stage of the disease is the reverse of this—it tends to aggravate and extend the disease, or to develop the second stage. This theory, then, will not account for the practical maxim, ‘not to apply a counter-irritant too early;’ because if, as is assumed in this theory, blood is withdrawn from the inflamed part by the application of a counter-irritant, the sooner the remedy is applied the better.

Again, in the second stage of inflammation the tissues are suffering from defective nutrition, and if the supply of blood to them is still further diminished a further deflection from the healthy standard will take place in the nutrition of the part; but the effect of counter-irritation is to deflect the nutrition of the part towards the standard of health. The supporters of this theory would probably give a different interpretation to the facts. They might say, and with a show

of reason, that if the flow of blood to the part were diminished in the second stage of inflammation, the *vis a tergo* being thus lessened, the pressure exerted upon the tissues would not be so great, and thus a freer scope would be afforded to the cells to undergo changes and to procure absorption of effused fluids. It might be maintained in this manner that, by diminishing the flow of blood to a part in the second stage of inflammation, the tendency would be to elevate the nutrition of that part, and thus to restore it to a state of health. I do not think that this reasoning is correct, but, instead of wasting time in opposing it, let it be granted that the second empirical law is accounted for by this method of argumentation. By no method of argumentation, however, can this theory be made to account for the third empirical law, namely, that counter-irritation tends to promote a return to health in certain morbid states of non-inflammatory origin, and which further analysis has shown to be characterised by defective nutrition. Nothing can possibly be gained by withdrawing blood from the fibres of a semi-paralysed bladder. When the muscles of the extremities are kept motionless for some time with the splints and bandages used in the treatment of fractures, they suffer from defective nutrition. The treatment consists of friction with stimulating liniments and constant exercise, both of which tend to bring more blood to the muscles. It cannot, therefore, be supposed that when an internal muscle, or, indeed, any other structure, is suffering from defective nutrition, any advantage will accrue from an agent which withdraws blood from it.

But this theory assumes that counter-irritation acts by withdrawing blood from the morbid structures in its vicinity, and it has just been seen that no beneficial result can be obtained by diminishing the supply of blood to a morbid part suffering from defective nutrition without previous inflammation; therefore, according to this theory, counter-irritation is inadmissible in the treatment of such cases. But the third empirical law asserts that counter-irritation tends to promote a return to a healthy condition in certain cases found by further analysis to be cases of defective nutrition of non-inflammatory origin; hence the theory will not account for the third empirical law.

The fourth empirical law relates to the variations of the effects of counter-irritation, according to its distance from the morbid part to be influenced; the fifth to the variations of the effects, according to the intensity of the counter-



irritation ; and the sixth to its effects upon internal organs ; and since it has been admitted that the assumption this theory makes is a *vera causa*, it will be useless to apply these empirical laws as tests of the validity of the theory. With regard to the third test of a scientific hypothesis, namely, that it be proved that no other hypothesis can account for the phenomena, it may be remarked that the aim of this inquiry is to arrive at a theory that will account for the phenomena ; therefore, if the inquiry is conducted to a successful issue, it will be the best possible proof that this and the other hypothesis to be hereafter considered fail to satisfy the third test.

Having shown that the derivation theory is not confirmed by the experimental verification, it might be rejected without further consideration. But it may be useful to follow this theory to its logical consequences, because, if it can be shown that fictitious and dangerous practical maxims can be deductively inferred from it, this may carry greater conviction to some minds than the inability of the theory to satisfy the tests already laid down. The theory does not account for the empirical laws of the effects, but other laws can be deduced from it ; and since the empirical laws and the deduced laws do not coincide, the latter must be fictitious and erroneous. The following are some of the laws which may be deductively inferred from the derivation theory. In the first stage of inflammation there is an influx of blood to the part, which occurs in obedience to a diseased impulse, and if this inflow of blood can be arrested it is possible to check the disease. It has already been noticed that when the inflamed part is near the surface this end is accomplished by pressure and by the application of cold. If, therefore, counter-irritation acts by withdrawing blood from a morbid part, this is the time for its employment ; and if this deduction is enunciated as a practical maxim, with so much of the grounds upon which the maxim is founded attached as will render it intelligible, the form it will assume is this :—"In the treatment of inflammation employ counter-irritation as early as possible, in order that the disease may be checked." Does experience verify this deduction, and the maxim founded upon it ? In the second stage of inflammation the tissues of the part are suffering from defective nutrition. The circulation is already sluggish, therefore it would not be judicious, were it possible, to divert the blood from the part in this stage of the disease. When the inflamed part is near the surface

of the body warm applications are employed. But warmth is known to increase growth, and if counter-irritation diminishes the flow of blood to a morbid part in its vicinity its employment in the second stage of inflammation is inadmissible, and the more chronic the inflammation became the more injurious the employment of counter-irritation would be. The form the practical maxim founded upon this deduction will assume is this:—"Do not employ counter-irritation in the second stage of inflammation, and more especially avoid its employment when the disease is chronic, for fear of aggravating it." Does experience verify this deduction, and the maxim founded upon it? It would be extremely injudicious to withdraw blood from a morbid part suffering from defective nutrition without previous inflammation. Therefore the effect of counter-irritation in such cases would, according to this theory, be most injurious. Does experience verify this deduction? In inflammation of the elbow-joint, for instance, it would be more philosophical, according to this theory, to apply a counter-irritant to the neck, another to the surface of the chest, and a third over the deltoid muscle. In this manner part of the blood that would otherwise proceed along the brachial artery to the inflamed joint would be diverted by the first irritation along the carotid and thyroid arteries, by the second along the internal mammary and the thoracic branches of the axillary artery, and by the third along the circumflex arteries. This would, according to the theory, greatly diminish the flow of blood along the brachial artery, and the supply of blood to the morbid part would be more reduced than it could be by the application of a counter-irritant near the joint. In inflammation of the lungs it would be preferable to apply a counter-irritant between the scapulæ, no matter in what part of the lungs the disease might be, since in this situation the counter-irritation might be expected to have a more direct influence over the circulation in the vessels entering the roots of the lungs. Does experience verify these deductions? Let every practitioner answer these questions for himself. As for me, I am fully persuaded that the deductions, although true conclusions from the theory as premises, are false when considered as representations of the facts; and that the maxims founded upon them are purely fictitious, and, if relied upon, will lead to dangerous errors in practice.

To sum up, then, this theory is liable to the following fatal objections:

1. That there are strong reasons for believing that when a counter-irritant is applied to one part of the body this does not diminish the flow of blood to the textures in the vicinity of the irritated part more than it does the flow of blood to any other part of the body—in other words, there is strong presumptive evidence that the cause assumed by the theory under consideration is not a *vera causa*.

2. Granting that the cause assumed is an actually existing antecedent, it is insufficient to account for the empirical laws of the effects.

3. That the laws which may be deductively inferred from this theory are erroneous, and if relied upon in practice will lead to dangerous errors.

This hypothesis, therefore, ought to be rejected, having been found to be without foundation, in fact, inadequate in its explanation, and unsafe as a guide in practice.

II. Is the blood the medium of communication between the counter-irritation and the morbid process in its vicinity? A gentleman whose abilities and professional attainments I entertained (alas! that I should have to speak of him in the past tense) the utmost respect, once told me that, in his opinion, counter-irritation acted by producing an inflammatory condition of the blood. I presume this theory has few supporters. I do not, therefore, intend to review it at any great length. But in the first place I am bound to acknowledge that the cause assumed is a *vera causa*, therefore the changes in the blood caused by the counter-irritation will produce some effect upon the body. A greater amount of nourishment is withdrawn from the blood in order to repair the injury caused by the counter-irritant, and this will tend to weaken the powers of the system. But this general effect will react upon the morbid structure in the neighbourhood of the counter-irritation, and it will tend to lower the nutrition of that structure as well as that of the whole body. This, however, will not account for the action of counter-irritation either in the first or the second stage of inflammation. And least of all will it account for its action in cases of defective nutrition of non-inflammatory origin. Nor will this theory account for the fourth empirical law. In inflammation of the lungs, for instance, those organs would not be more freely supplied with inflammatory blood when a blister was applied to the surface of the chest than they would be when a blister was applied to the sacrum. Therefore, according to this theory, the effect of a blister applied to



the sacrum or any other part of the body, would produce as marked an effect as if the blister were applied to the surface of the chest. This, however, contradicts the fourth empirical law.

But this theory might assume another phase, since not only does the counter-irritation withdraw certain materials from the blood, but other materials, the waste products of the irritated part, are absorbed into the blood. Now, although these products are effete so far as the irritated part is concerned, they may be used in the nourishment of another part of the body. It was the opinion of Treviranus that "each single part of the body, in respect of its nutrition, stands to the whole body in the relation of an excreted substance." This idea has been beautifully developed by Mr. Paget in his theory of what he calls 'complemental nutrition.' According to this theory, "certain organs stand, in their nutrition, in a complementary relation to each other, so that neither of them can be duly formed or maintained in healthy structure unless the right condition of the blood be induced or preserved by the formation of the other." It is probable that the *mammæ* are, in their nutrition, the complement to the uterus, and it is therefore possible that an irritant applied to the latter would affect the nutrition of the former organs. Our ignorance of this subject is so profound that it is difficult to say what would be the effect that would be produced on one organ by irritating another organ to which the former stood in the relation of nutritive complement. But the following consideration will enable us to see that, whatever the effect may be, it will not account for the action of counter-irritation. When a blister is applied to the surface of the chest it tends to procure the absorption of fluid in a case of pleurisy, and it also tends to diminish the quantity and to improve the quality of the muco-purulent discharge in a case of bronchitis. It surely cannot be maintained that structures differing so entirely in their functions and composition as a serous and a mucous-membrane both stand in this complementary relation to the same structure, namely, the surface of the chest, to which the counter-irritant is applied. This argument might be elaborated still further, but as this is a theory which is not adopted by any one it requires no further notice.

III. A theory of the action of counter-irritation has been founded upon each of the two great nervous systems—the cerebro-spinal and the sympathetic.

The revulsion theory refers the action of counter-irritation to the cerebro-spinal system of nerves. This theory supposes that in consequence of the external irritation the attention of the nervous system is withdrawn from the morbid process going on in the internal organ, and in this manner time is given to the latter to regain its original integrity. According to this view, a current of nervous force is being conveyed by the nerves to every part of the body, which stimulates the tissues to maintain their nutrition. Now, when under an abnormal stimulus the tissues of a part assume a high action, if the current of nervous force can be withdrawn in whole or in part, a certain stimulus that keeps up high action is taken away, and this allows the inflamed textures to regain their normal action. The revulsion theory is only another phase of the old doctrine of counter-irritation already noticed, namely, the derivation theory. When, therefore, the analogy between the two theories is pointed out it will be unnecessary to enter into a lengthened refutation of the revulsion theory. Both theories assume that counter-irritation allays high action, and as the one theory explains this by supposing that a certain amount of blood is withdrawn, so the other by supposing that a certain amount of nerve force is withdrawn from the morbid part. Therefore all the objections that have been urged against the former theory can be urged against this one. It is impossible for its supporters to prove that the current of nerve-force is diverted from the morbid part to the irritation artificially produced—in other words, they cannot prove that the cause assumed is a *vera causa*. And granting the cause assumed to be a *vera causa*, it will not account for the empirical laws. In the first stage of inflammation counter-irritation never does directly allay, but may increase, the action. In the second stage, and in the other examples of abnormal nutrition already mentioned, it would be very injudicious, if possible, to withdraw the attention of the nerves, as our great object is to increase nutrition. It could easily be shown that this theory followed to its logical consequences would lead to rules of practice as erroneous as the former.

Great attention has of late years been paid to the action of the sympathetic system of nerves, especially to its power of affecting the calibre of the blood-vessels. "The sympathetic nerve," says Kirkes, "possesses great influence over the contractile power of the blood-vessels, division of the



trunk or branch of such nerve being followed by paralysis of the coats of the vessels supplied by the ramifications of the divided nerve, and by consequent congestion and increased temperature of the parts in which such vessels are distributed; while galvanic or other stimulus to the nerve is followed by contrary effects, namely, by contraction of the vessels, and by diminution in the quantity of blood and in temperature." Upon these facts it has been attempted to found a theory explanatory of the action of counter-irritation. The theory is thus stated by Virchow:—"If then," he says, "we have to deal with hyperæmia the result of irritation, the most important point therapeutically is just to place the vessels in such a state of activity as will enable them to offer resistance to the onward rush of blood. This we can accomplish by the means of what is called counter-irritation, a higher degree of irritation in an already irritated part stimulating the fatigued muscular fibres to persistent contraction, and thereby diminishing the supply of blood and leading the way to a regulation of the disturbance." In the first place, the supporters of this theory have not proved that the cause assumed is in all cases a *vera causa*. For instance, they have not proved that irritation of the surface of the chest will diminish the calibre of the blood-vessels of the lungs; and still less have they proved that irritation of the anterior surface of the chest will constrict the blood-vessels in the anterior parts of the lungs more than it does those of the posterior portions of the lungs, which ought to be the case if the fourth empirical law is true.

But as I do not intend to prove the converse proposition, namely, that irritation of the surface of the body is not followed by constriction of the blood-vessels of the internal organ subjacent to the counter-irritation, I shall leave this test and pass on to the experimental verification. When Virchow speaks of placing "the vessels in such a state of activity as will enable them to offer resistance to the onward rush of blood," it is evident that he is alluding to the first stage of inflammation, that is, before exudation takes place. That this is the view he takes is made more manifest when he says that counter-irritation acts "by stimulating the fatigued muscular fibres of the vessels to persistent contraction, and thereby diminishing the supply of blood and leading the way to a regulation of the disturbance." If it be true, therefore, that counter-irritation acts by diminishing the supply of blood to the morbid part through the medium of

the sympathetic nerves, it ought to manifest a tendency to cheek inflammation in the first stage of its progress. This is what Dr. Chapman attempts to accomplish in the first stage of inflammation of the lungs by applying heat along the spine. This gentleman maintains that contraction of the blood-vessels of the lung ensues, and in this manner a cheek is given to the inflammation. But the effect of counter-irritation in the first stage of inflammation is the reverse of this; instead of checking, it may aggravate the process, and when it does not aggravate the disease it merely assists in developing the second stage. Therefore this theory does not account for the first empirical law. In the second stage of inflammation nothing could be gained by procuring contraction of the blood-vessels leading to the part, since it is already suffering from defective nutrition. Dr. Chapman maintains that in the second stage of inflammation great benefit results from procuring further dilatation of the vessels supplying the part with arterial blood. In the second stage of inflammation of the lungs he applies cold along the spine, which, he says, has the effect of reducing the vitality of the sympathetic ganglia situate along the spine. By this means the influence of the sympathetic nerves is withdrawn in a great measure from the pulmonary and bronchial arteries. The consequence is that these arteries dilate and admit more blood to the lungs. I do not pronounce an opinion on the truth of Dr. Chapman's theory, nor on the success of his practice, it would be premature to do so at present; but the two are in such direct contradiction that either the one or the other must be erroneous. The supporters of this theory might maintain that in the second stage of inflammation the blood-vessels of the part are dilated and the circulation through them sluggish; therefore, if the vessels of the part could be constricted it might be supposed that the blood would circulate more freely, and in this manner that the nutrition of the part would be raised. But the capillaries are not supposed to be directly under the influence of the sympathetic system of nerves, and nothing could be gained by procuring contraction of the smaller arteries leading to the inflamed part in the second stage of the disease. But even if it be admitted that this theory will account for the second empirical law, it will not explain the action of counter-irritation in those lesions which are characterised by defective nutrition, but without previous inflammatory action. In those cases the capillaries are not dilated and engorged with sluggish blood; therefore, if the blood-



vessels leading to the part were constricted, this would diminish the supply of blood to it, and cause its nutrition to deviate still further from the line of health. But this contradicts the third empirical law, which asserts that in cases of defective nutrition of non-inflammatory origin counter-irritation tends to restore the part to its original nutrition. I shall leave it an open question whether this theory will account for the remaining empirical laws; enough has been said to show that it has failed to satisfy the demands of the experimental test, and therefore it ought to be rejected.

IV. Another theory of counter-irritation, if theory it may be called, is that it stimulates the absorbents. The vagueness of this theory makes it difficult of refutation. If it means that counter-irritation tends to procure absorption of effused fluids the result of inflammation, then it is merely an expression of a fact, and this fact is embodied in the second empirical law, namely, that counter-irritation tends to promote a return to health in the second stage of inflammation. If, on the other hand, it means that counter-irritation stimulates the absorbing vessels to an increase of their action, it becomes necessary to inquire what are the absorbing vessels in cases of inflammatory effusion. Let us attend to what takes place in a case of pleurisy with effusion. What are the absorbents in this case? Before absorption can take place the absorbing vessels have to undergo a certain degree of development, capillary vessels have to grow, and a membrane has to be formed bearing a close resemblance to a mucous membrane, and when this membrane is once formed absorption will follow as a necessary consequence. Therefore, when counter-irritation is employed immediately after effusion has taken place into the sac of the pleuræ, to maintain that it stimulates the absorbents is to maintain that it stimulates what has no existence. But even were it true that counter-irritation does stimulate the absorbents in cases of inflammatory effusion—and on this supposition the existence of the absorbents prior to the application of the counter-irritant must also be assumed—this does not explain to us how the influence is conveyed from the surface to the interior. This theory, therefore, does not afford an adequate explanation of the effect of counter-irritation even in a case of inflammatory effusion, and does not pretend to offer an explanation of its effect upon other lesions of nutrition. Therefore this interpretation of the theory may at once be rejected without any further application of tests.



But if this theory means that the influence exerted by artificial irritation of the surface is conveyed to the morbid structure beneath by the absorbents proper, it is equally untenable. It is especially untenable in the case of internal organs, since there is no direct communication between the lymphatics of the lungs, for instance, and those on the surface of the chest. At the same time, there can be no doubt that the lymphatic vessels are capable of conveying a certain influence from an irritated part to a distant part of the body. For instance, a small scratch on one of the fingers may cause inflammation of a lymphatic vessel to take place, and this inflammation may extend in a very short time to the axillary glands. Now, I shall not say what effect might be produced upon a morbid structure through which the inflamed vessel had to pass. It is clear it would have some influence, but, since there is no direct communication between the lymphatics of the surface of the body and those of internal organs, this interpretation of the theory leaves the action of counter-irritation upon internal organs still unaccounted for. But the inflammation of a lymphatic which may be originated by counter-irritation will cause enlargement of the nearest gland to take place; therefore it may be presumed that a less irritation than that capable of producing inflammation of the lymphatics may be sufficient to cause such an amount of irritation in them as to produce a change in the irritation of the gland, and, if this nutrition be long continued, of causing a permanent change in its structure. And if Virchow's theory, that a continued irritation and enlargement of lymphatic glands will cause the condition of blood which he calls leucocyto-sis, be true, then this effect of counter-irritation, especially when long continued, becomes very important; but however important, it will not account for the effects of counter-irritation embodied in the empirical laws. Therefore this interpretation of the theory, that counter-irritation acts by stimulating the absorbents, may also be rejected.

Having now examined most, if not all, of the current theories, and rejected them, it devolves upon me to undertake the synthetical operation by which a theory of the action of counter-irritation can be constructed.

It has already been remarked that in constructing our theory three things have to be considered—the morbid structure, the irritation artificially produced, and the tissues intervening between these. The intervening tissues have

been taken as the basis upon which the various hypotheses on this subject have been classified, and the only tissue which has not already been considered is the proper parenchyma. It remains, then, to be seen whether the ascertained properties of cells are such as to make the parenchyma capable of being the medium of communication between the artificial irritation and the morbid texture.

Let us attend first to the successive changes which take place when inflammation is excited on the surface of the body, such, for instance, as a pustule produced by the application of tartar-emetic ointment. The theory of inflammation which I adopt has already been considered, therefore it is



unnecessary to describe minutely the changes which take place during the formation of the pustule. It is enough to say that the centre of the pustule is in the second stage of inflammation, and that surrounding this centre there is a red zone, gradually fading at its circumference into the colour of the surrounding skin, which exhibits the first stage of the process. But does the influence of the irritation caused by the pustule cease where we fail to recognise any engorgement of the blood-vessels by the naked eye? Even analogy from the physical world would lead us to give a negative answer to this question. Take sound, for instance; no one will maintain that the undulating motion of the air ceases when sound ceases. The only conclusion the natural philosopher comes to is, that the number of vibrations in a given time are so few as to be incapable of causing the sensation. From analogical reasoning, therefore, it may be concluded as highly probable that the influence of the inflammatory centre extends beyond the limits of the red zone

surrounding it. But analogical considerations are not the only ones which will indicate this conclusion. After alluding to a specimen in the College of Surgeons' Museum, which Mr. Hunter described long ago "as a sore which had continued inflamed a long time, where the increased action had made the hair grow," Mr. Paget adds, "Similar examples of over-growth of the hair through increased supply of blood, assisted by more than usual external warmth and moisture, are frequently seen near the ends of stumps which have remained long inflamed, and about old diseased joints; not, indeed, at the very seat of inflammation, but at some little distance from it, where the parts share the increased supply of blood, but not the disease of inflammation."

The question now arises, whether is the over-growth of the hair the effect of the increased supply of blood, or are the growth of the hair and the increased supply of blood both the effects of the increased activity of the tissues surrounding the inflammation? The latter is the view which I shall adopt. According to this view the growth of hair which occasionally takes place on the skin surrounding a long-continued sore is caused by the irritation which spreads from the inflammatory centre, and not from the surrounding skin being more freely supplied with blood. This irritation is conveyed along the parenchyma, that is, one cell communicates the change it is undergoing itself to the one next to it, that change becoming less and less in degree as the cell is further removed from the inflammatory centre. This assumption is perfectly legitimate, for it is a recognised property of a cell that it is capable of communicating a change it is itself undergoing to a neighbouring cell, therefore this property is a *vera causa*. No new and unknown agency is invented; the only assumption made is to widen the sphere of action of an agency known already upon independent evidence to be an antecedent, and capable of exerting an influence over the effect. Therefore, as the result of this part of the inquiry, it may be concluded that beyond the inflammatory zone there is another where the tissues are stimulated to increased activity, and that this activity is caused by the spread of the irritation along the parenchyma of the part. But not only does irritation spread along the surface of the body, but it spreads in all other directions; and if it be true that there is an area on the surface surrounding an inflammatory centre, the parenchyma of which is stimulated to increased activity, it is equally true that a



similar area will be found deep amongst the tissues. This conclusion is a deduction from the former argumentation, but it can be verified by reference to observed facts. I once saw a case where the fang of a carious incisor tooth made its way through the alveolar process and the gum, and about one tenth of an inch of the apex of the fang was projecting into the upper lip. The man was very nervous, and for a long time bore the pain caused by the tooth rather than make up his mind to have it extracted. On the outside, exactly opposite the ulceration caused by the apex of the fang of the tooth in the upper lip, there was a red spot about the size of a sixpence, painful, and very tender to the touch. In this case the irritation had travelled from within outwards. Mr. Simon, in a foot-note in his essay on "Inflammation" in Holmes's 'System of Surgery,' says—"Dr. Greenhow informs the writer that it happened to him once, in making the post-mortem examination of a patient to whose abdomen a blister had been applied, to find on the inner surface of the abdominal wall a red patch (probably of more injected muscular substance seen through the peritoneum) corresponding to the area of the blistered skin." It may, therefore, be concluded that where there is continuity of tissue there is an area of texture surrounding every inflamed part, the parenchyma of which is stimulated to increased nutritive activity.

I must now advance one step further and endeavour to show that irritation spreads, not only when the structures are continuous, but also when they are merely contiguous. As an instance of the spread of irritation from one structure to a contiguous structure, it may be noticed that the indications of inflammation are rarely seen in the pleura costalis without similar indications being seen in the corresponding portion of the pleura pulmonalis. In a case of tubercular consumption, when the tubercles lie near to the surface of the lung, they very generally give rise to adhesive pleurisy. "That the pleurisy and adhesion," says Watson, "are consequences of the presence and irritation of the tubercles appears from this—that, for the most part, the extent and the situation of the adhesions correspond with the extent and the situation of the tubercular disease. Thus, a single spot of adhesion has been seen to unite the costal and pulmonary pleurae exactly opposite a solitary tubercle which lay near the surface of the lung." Little can be said regarding the proximate cause of the spread of irritation from one structure to another with which it is simply in contact, but the ultimate cause is

easily pointed out. It is the great conservative principle by which nature prevents communication being formed between the shut cavities and the internal organs in certain diseases of the latter, such as vomica of the lungs, abscess of the liver, ulcer of the stomach, &c. But, in truth, just as little can be said with regard to the manner in which irritation propagates itself when there is continuity of tissue; both must be accepted, at any rate in the present state of our knowledge, as ultimate facts. It shall, therefore, be assumed here that one structure is capable of communicating a change which it is itself undergoing to another structure with which it is in contact, and that the communication takes place directly from the one structure to the other, and not indirectly—either through the blood-vessels, the blood, the nerves, or the absorbents. And here, again, the assumption is perfectly legitimate; no new agency is invented, the only supposition made is that a known agency is operative under a new set of circumstances. Hence the agency assumed is a *vera causa*. But even if it be granted that the transmission of irritation from one part to another is an action of the parenchyma, that irritation will spread directly from one structure to another with which it is simply in contact, and that surrounding every inflammation there is an area the tissues of which have been stimulated to increased nutritive activity, yet the extent of this area is still undetermined. Many will find it difficult to conceive that irritation of the surface of the body will in this manner travel inwards to such an extent as to affect within a short time the internal organs. This does not constitute any real objection to the theory, because difficulty of conception is a state of the mind, and there may be no corresponding difficulty in nature at all. It is the difficulty which the mind always finds in acquiring a new idea which is at variance with other ideas already acquired. The following considerations may help to remove this difficulty; but let it be observed that they are not intended as arguments in favour of the theory, but simply as types upon which to found the idea, in order that it may be the more easily conceived.

In the study of matter in its physical conditions it is found that certain forms of it, when undergoing chemical decomposition, when added to certain other forms, are capable of communicating motion to the molecules of which the latter are composed, and of involving them also in chemical change. It will not, therefore, be difficult to conceive that motion communicated to one part of the ever-changing, ever-active



elements of which living tissues are composed should soon be propagated to the surrounding molecules, nor will it be difficult to conceive that this motion should make its way from one structure to another in contact with it. It is also a well ascertained fact that a very extensive series of changes may be set in motion within the body by a cause which would be regarded as inappreciable if measured by any known standard of comparison except the effects which it produces on the living body. Inoculation with a small quantity of the secretion of smallpox may be cited as an example. These considerations, therefore, may assist the mind in forming the conception that irritation of the surface of the body may spread directly through the tissues, and to such an extent as to produce an action upon the internal organs. But even after it is conceded that irritation of the surface of the body spreads inwards to such an extent as to affect the internal organs in some degree, another difficulty remains to be solved. It might be urged that the intensity of this irritation is not so great as to account for the action of counter-irritation upon the morbid structures in its vicinity. When the surface of a healthy body is irritated there are no apparent signs by which it can be recognised that the irritation has extended beyond the immediate neighbourhood to which the irritant has been applied, and even when the irritation has been long continued the only appreciable signs of the extension of the irritation to the surrounding textures are such as are afforded by the over-growth of the hair. The effect, therefore, which irritation produces upon the surrounding healthy textures being so small, it may be argued that the force which causes this effect must be so feeble as not to account for the almost immediate and even marked effects counter-irritation produces upon morbid structures. This constitutes a real difficulty, but it is one which is not peculiar to this theory, but will arise whatever theory of the action of counter-irritation may be advanced. At the same time, if a solution of this difficulty can be obtained it will be an additional argument in favour of the theory under consideration. In the first place, it may be remarked that the force derived from the counter-irritation is not the sole cause of the effects produced upon the surrounding textures, whether these textures are in a healthy or in a morbid condition. The force derived from the counter-irritation merely acts along with a force or forces already existing in the part. It is not the sole cause of the effects; it is, as Sir W.

Hamilton terms it, only a 'con-cause.' Therefore, the effects produced by counter-irritation, either upon a healthy or a diseased structure, is the resultant of two or more forces.

In a healthy structure there exists the force which maintains the part in health. By applying a counter-irritant a force is called into operation which tends to deflect the structures in the vicinity from the line of health. But the force which maintains the part in health, being a constant force, tends now to counteract the deflection produced by the force derived from the counter-irritation. Hence, when a part is slightly irritated, if the cause which has produced the irritation is withdrawn the part soon regains the healthy type of nutrition. The forces, then, existing in this case tend to counteract each other, and this sufficiently explains the inappreciable effect of counter-irritation upon the healthy structures in its vicinity. In the case of a morbid structure it will be hereafter shown, when I come to apply the experimental test, that the force derived from the counter-irritation tends in the same direction with other active forces in the part, they are concurring forces; hence the marked effects produced upon morbid structures by counter-irritation.

Having stated the theory, and endeavoured to remove a few difficulties, I shall now proceed to test it by the laws of a scientific hypothesis.

The first test has already been applied when stating the theory, for it was shown that in the assumptions made no new cause was devised, but a known cause was assumed to be operative under new circumstances—in other words, the causes assumed were proved to be *veræ causæ*.

I may, therefore, pass on at once to the application of the experimental test—in other words, to see if the theory will account for the empirical laws already laid down.

The first law is, that in the first stage of inflammation counter-irritation has a tendency to develop the second stage, and also has a tendency, which is not manifested on all occasions, to extend and aggravate the disease. Now, this is exactly what a stimulant might be expected to do, of course assuming the correctness of the theory of inflammation adopted. When a structure which is in the first stage of inflammation is stimulated to a still greater increase of action more blood will flow to the part. Now, if the additional influx of the blood to the part is immediately attended with effusion, the second stage of the disease will be developed; but if effusion does not immediately take place,



the disease will be aggravated, since the inflamed structure has been stimulated to increased activity. In this case the impulse by which the part was originally deflected from health, and the force derived from the counter-irritation tend in the same direction; hence the two forces are concurring, and the effect produced will be more marked than that produced by two opposing forces.

The second law is that in the second stage of inflammation counter-irritation tends to advance the progress of the disease towards health. And this, again, is what a stimulant might be expected to effect if the second stage of inflammation is characterised by defective nutrition. It has already been concluded that surrounding an inflammatory centre, on all sides, there is an area of texture which is stimulated to increased activity; therefore if a morbid structure, the nutrition of which is defective, comes within the limits of this area, its tissues will be stimulated to increased growth, and a return to the condition of health will be promoted. This will hold true whether the defective nutrition has or has not been preceded by a stage of excessive nutritive activity. Therefore this theory will account, not only for the second, but also for the third empirical law, which expresses the action counter-irritation produces upon morbid textures suffering from defective nutrition without previous inflammation.

It has already been shown, in stating the theory of inflammation, that there is operating upon a part in the second stage of inflammation the formative or constructive force, which tends to restore the part to the healthy standard, and this force is also operative upon structures suffering from defective nutrition of non-inflammatory origin. And it has just been noticed that counter-irritation stimulates to increased activity the tissues of structures suffering from defective nutrition; hence the force derived from the counter-irritation and the formative force existing in the part co-operate to produce the effect. This explains why counter-irritation produces a more marked effect upon structures suffering from defective nutrition than it does upon healthy structures.

The fourth empirical law relates to the variations that take place in the effects of a counter-irritant upon a morbid structure, according to the locality to which it is applied. The practical rule is, that a counter-irritant must not be applied too near the morbid part (especially in inflammation,



to which this rule is principally applicable), for fear of lighting up a fresh inflammation, nor too far away, as in that case it will not influence the part at all. It is difficult to read any intermediate history between these extremes than that, when a counter-irritant is placed too near a morbid part, it is capable of stimulating in excess, and producing the first stage of inflammation; when applied a little further off, it stimulates sufficient to raise low action; another degree further removed, it is still capable of stimulating the morbid part, but not so powerfully; and when applied at a still greater distance it is not capable of influencing the part at all. Therefore the maxim by which the practitioner is guided in the choice of the locality to which to apply a counter-irritant can be readily deduced from this theory.

The fifth empirical law, which relates to the variations that take place in the effect according to the intensity of the irritant, can also be deduced from this theory. It is simply a case of the concomitance of the variations in the effect with the variations of the cause. When the irritation produced is slight, the stimulation of the surrounding tissues will also be slight; when more severe, the stimulation will also be greater and more prolonged, because when there is destruction of tissue the stimulation will be maintained till the reparative process is completed.

The explanation of the sixth empirical law is involved in the assumption made that irritation spreads along the parenchyma of the part when the structures are contiguous as well as when they are continuous. Therefore, so far as the effects of counter-irritation embodied in the empirical laws are concerned, the theory has fulfilled the requirements of the experimental test.

With regard to the final test of a scientific hypothesis, namely, that it be proved that no other hypothesis can account for the phenomena, it may be remarked that the examination and rejection of the various hypotheses current to account for the effects of counter-irritation are an attempt to fulfil the requirements of this test—an attempt, but not an entirely successful one. What has been proved only amounts to this, that no other hypothesis has hitherto, so far as I am aware, been constructed that accounts for the phenomena; not that no other hypothesis can be constructed that will account for them. Something has been proved with regard to what man has not accomplished in elucidating the course of nature, but what the test requires is to prove

something with regard to the course of nature herself. Therefore I am not entitled to assume, because no other theory has been constructed, that no other theory ever can be constructed that will account for the phenomena.

I can imagine a neuro-pathologist accounting for the phenomena in the following manner:—It is an ascertained fact that the nutrition of a part becomes impaired if the influence of the nerves is cut off from it; therefore it may be assumed that the nervous centres are constantly sending currents of nerve-force along the nerves, which act by stimulating the tissues of the body to increased action.

When inflammation is excited on the surface it may be argued that the irritation is conveyed by the nerves to the nervous centres, and that it is reflected thence along the efferent nerves to the internal organs or to the morbid part to be influenced. The current of nerve-force coming from the nervous centre being now greater than in a state of health, the morbid textures are stimulated by it to greater activity. This theory would account for the action of counter-irritation being of a stimulant nature, but it would not account for its action being so very local as it is found to be. This action, however, is a real one, and, although it will not account for all the empirical laws already laid down, it may co-operate with the influence conveyed directly through the parenchyma; and it may also be worth while to try in practice what can be accomplished by producing artificial irritation of a part supplied by a nerve, another branch of which is itself in a morbid state or which presides over the nutrition of a diseased locality. But if the effect of counter-irritation is of a stimulant nature, as I have endeavoured to prove, I cannot conceive how its action can be explained by regarding the sympathetic nerves as the medium of communication between the artificial irritation and the diseased structure. I am still further at a loss how that action can be explained by the changes which the artificial irritation can produce in the constitution of the blood itself, or from any changes it can produce in the surrounding circulation, or from any action it can exert over the absorbents proper. I do not, however, wish to limit the possibilities of nature by my powers of conception; therefore it must be admitted that, although no other theory has ever, so far as I am aware, been constructed that will account for the phenomena, it is possible, for anything that has been proved here, that another theory may at some future time be constructed that will account



for them. Therefore this theory does not fully satisfy the demands of the third test of a scientific hypothesis. This theory, then, is not raised to the level of a rigid induction, and probably in the present state of physiological and pathological science such a rigid demonstration cannot be expected; hence the theory can only be regarded as a plausible, I venture to add, a very plausible, hypothesis.

Let it be observed, however, that not one, but two hypotheses have been advanced, and I am anxious to draw particular attention to this fact because the truth of the one is not depending upon the truth of the other. The first hypothesis is that the influence transmitted from an inflamed surface to a neighbouring morbid texture is conveyed through the medium of the parenchyma, while the second merely asserts that the influence is in its nature that of a stimulant. Now, if the second hypothesis is granted, namely, that the effect of counter-irritation is of a stimulant nature, both when it acts beneficially and prejudicially, as practical men we need not care so much how that action is transmitted. The scientific man studies the course of nature without troubling himself with practical results, therefore he cannot rest satisfied with anything short of an explanation of the entire process; the practical man aims to bring about a desirable result; hence the hypothesis which endeavours to give a connected account of the whole process is the more important so far as the science of medicine is concerned, but as regards the art of medicine the more important hypothesis is the one from which practical maxims for the guidance of the conduct can be readily deduced. Therefore the hypothesis that counter-irritation produces its action by stimulating the textures in its vicinity to increased growth is a very important one, so far as the art of medicine is concerned—it is one of the *axiomata media* of Bacon, and which he regards as constituting the chief value of any science. This hypothesis is capable of being proved in two ways; the proof attempted here has been the deductive one. It has been argued from the laws of nutrition, and the theory of inflammation, that the influence exerted upon the tissues surrounding an inflamed part is of a stimulant nature; but the same hypothesis might be arrived at inductively, that is, by noting instances of the effect, and observing that in each case it was preceded by a stimulation of tissue; and the two proofs, though they very much strengthen, are not necessarily dependent upon each other. The deductive proof may be



entirely false except in the conclusion, for a true conclusion may be arrived at from false premises, and the inductive proof may be entirely true.

If, then, it be granted that both the prejudicial and beneficial effects of counter-irritants arise from their power of increasing the nutritive activity of the structures in the neighbourhood of which they are applied, let us see what are the practical results which must follow.

1. The more important maxims by which the practitioner is guided in the treatment of disease by counter-irritation can be readily deduced from this theory. One practical rule is, not to employ counter-irritation in the beginning of inflammation. If counter-irritation allays high action it is difficult to understand why it should not be employed in the early stage of inflammation, but if it stimulates low action the necessity of the caution implied in the rule is at once apparent. On the other hand, it becomes very evident why counter-irritation should be employed during the second stage of inflammation and in other states of defective nutrition.

2. This view will be found to be in strict harmony with the theories held regarding the *modi operandi* of other agents employed along with counter-irritation in the cure of disease. In a case of chronic bronchitis, for instance, a blister may be applied to the surface of the chest, while squills is given internally. It would be very difficult to distinguish between the action these agents will produce on the mucous membrane when employed separately. Both diminish the expectoration in quantity and improve it in quality, yet the one is called a stimulant expectorant while the other is supposed to allay or control the inflammation. Pareira is believed to have a stimulant action on the mucous membrane of the bladder, and it is given with great advantage in chronic inflammation of that membrane. The application of a blister over the pubes has also a beneficial tendency in such a case. Now, is there either sound logic or common-sense in giving a drug internally to stimulate low action, while externally an agent is applied to reduce high action? The action of the one would tend to counteract that of the other, according to the prevailing theories; yet experience fully attests that the one assists the other, and that both employed together have a more marked effect upon the disease than each used separately. Instances might be multiplied where drugs are given internally with the idea of

stimulating the morbid structures to increased activity, and it is in these very cases that counter-irritants are found to be so signally efficacious; therefore, if our theory of the manner in which the former agents produce their action is correct, there cannot be any possible means of avoiding the conclusion that the latter agents act by stimulating morbid textures.

3. If this theory is adopted it will lead to the disseverance of agents in theory which have long ago been dissevered in practice. In theory counter-irritants have been classed along with antiphlogistics, such as bloodletting, but in practice none but the most inexperienced would employ active antiphlogistics and counter-irritants at the same time and in the same stage of the disease. The practical rule is, that if bloodletting be resorted to at all it must be as early as possible, and before inflammation is fully established, while, on the other hand, the practical rule with regard to counter-irritants is that they must not be used too early for fear of aggravating the disease. The rule with regard to bloodletting is, employ it early in order to check the disease, and that with regard to blistering is, not to employ it early lest the disease may be aggravated. Here, then, is the broadest possible practical distinction drawn between the action of these agents, and yet both are classed together as antiphlogistics. It need scarcely be added that they are classed together from some supposed similarity in their action, while the practical rules already quoted assert in the plainest language that bloodletting and blistering are as dissimilar in their action as it is possible to conceive. Therefore, if bloodletting is to be taken as a type of antiphlogistic remedies, it is clear that blisters and counter-irritants generally cannot be included in that class. Counter-irritants are employed in the second stage of inflammation along with supporting and stimulating treatment, and along with internal medicines which are supposed to have a special stimulant action upon the structure in which the disease is localised; therefore, let them be taken out of the class of antiphlogistics and placed amongst the class of local stimulants.

4. One other reform must follow from the adoption of this theory. It is stated in therapeutic works that counter-irritants "allay," "control," "subdue" inflammation. If these words are to be taken in their ordinary acceptation they convey to the mind the idea that the direct tendency of counter-irritation is to reduce high action. This idea is very

much strengthened when these words are associated, as they frequently are, with the old theory of counter-irritation, which explains its action on the supposition that the artificial irritation withdraws a certain amount of blood from the morbid part in its vicinity; or when they are associated with the more recent theory that the artificial irritation procures constriction of the blood-vessels supplying the morbid part by means of the sympathetic nerves. But when these words are associated, not only with the theories alluded to, but also with the present classification, which places counter-irritants in the same category with bloodletting, the net by which the unwary and inexperienced practitioner may be entrapped into a dangerous error of practice could scarcely be laid with greater skill by a malignant being who made it his great aim to warp the intellect of the practitioner, so that he might be led to aggravate the disease while pretending to cure it. I therefore demand that the terms "allay," "subdue," "control," as applied to the action of counter-irritants upon inflammation, be expunged from our literature, as terms apt to mislead the inexperienced practitioner; and let it be granted that counter-irritants stimulate the morbid textures in the neighbourhood of which they are applied to increased nutritive activity, then our theory and practice will be in accordance with each other.







